An Assessment of Potential Direct and Indirect Impacts to Black Bear at the Proposed Deerfield Wind Farm Based Upon a Literature Review

Submitted to: Deerfield Wind, LLC
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I. Executive Summary

Interviews with experts and thorough literature searches of peer-reviewed papers and government EIS reports were conducted in an effort to assess the potential for direct and indirect impacts of the proposed Deerfield Wind Farm on native black bear populations.

Research indicates that when human development is undertaken, the most significant potential problem for black bears is the creation and use of roads. Disturbance to bears resulting from roads is likely proportional to the size and density of roads, the volume of traffic, and the nature of use (e.g., by hunters).

The information found through this review of pertinent literature and expert opinions suggests that the Deerfield Wind Farm – given the proposed use of unpaved roads which will be reduced in width after construction and gated to prevent public access -- would not pose an undue adverse impact to native black bear populations. Any disturbance or displacement that may occur is likely to be associated with activity on the access roads during construction and within a narrow band along the access road during access to the site for maintenance activities. The more significant potential disturbance, that from construction, should be limited in scope and duration.

II. Introduction

The following report is a literature review of the impact of selected anthropogenic features and activities on the black bear, also taking into account selected research on the brown and grizzly bear. Deerfield Wind, LLC has requested this work to aid in their efforts to site the Deerfield Wind Farm in Searsburg and Readsboro, Vermont.. To this end, the report focuses on the native bear of Vermont, the black bear. Attempts to review all relevant literature pertaining to black bears and human features and activities were made. Brown, and grizzly bear literature was not vigorously pursued. The findings of this literature review, combined with information obtained from other bear experts, was then applied to the expected conditions during the construction and operation of the proposed wind project to assess the potential for adverse impacts.

III. Methodology

Environmental databases were electronically searched using the University of Vermont (UVM) library system, and a similar database at Sterling College. The UVM and Sterling College database searches reviewed the *Zoological Record*, as well as dozens of relevant peer-reviewed journals. The UVM search system also allowed searches with Lexis/Nexis (including magazine and newspaper articles) and a general search of Environmental Impact

Bear experts that were personally contacted include: Michael Pelton (Virginia), Lynn Rogers (Minnesota), Dave Garshelis (Minnesota), Karen Noyce (Minnesota), James Cartoza (Massachusetts), Keith Aune (Montana), Martyn Obbard (Ontario), and Chris Servheen (USF&WS). Bear experts within state and provincial fish and wildlife agencies in New Hampshire, Michigan, Idaho, Wyoming, Colorado, California, Washington, Alberta, Manitoba and Ontario were also contacted.

In Vermont, Tom Decker, Scott Darling, Forrest Hammond, and John Austin (all of the Vermont Department Fish and Wildlife) were contacted. The files of Forrest Hammond and John Austin were reviewed and appropriate material was copied.

IV. Literature Review

In the following section, direct and indirect impacts on black and grizzly bears from tourism and trails, roads and road closures, energy and resource extraction projects, recreation, and residential land uses will be discussed.

Throughout this literature review, the term "avoidance" refers to less than expected use by bears of a habitat near a trail, road, house or other human development.

A. Tourism: Black Bears in Louisiana and Grizzly/Brown Bears In Alaska

Brown bears in Alaska's O'Malley River valley reacted differently to bear viewing activities (with no hunting) largely based on the nature and type of transportation of the viewers (Wilker and Barnes 1998). Forty-eight percent of brown bears fled (running or walking) from small wildlife viewing airplanes within approximately 100 m of their approach. Brown bears were also found to run and flee from powerboats, although no standard distances were presented.

Wilker and Barnes (1998) also found that wildlife viewers stalking brown bears with cameras caused the bears to be disturbed and the bears eventually left the area. The authors note that when wildlife viewers had hired guides with them, the level of disturbance generally decreased. This presumably was due to the guides maintaining a tighter control over the wildlife viewers, resulting in less disruptive behavior overall on the part of the viewers. Hightower (2001) found no aversion or attraction behavior by black bears to trails or low-traffic volume roads in Louisiana.

B. Trails: Black Bears and Grizzly Bears

Kasworm and Manley (1990) found that in Montana, black bears utilized habitat within 122 m of a hiking trail less than expected in spring and within 305m less than expected in fall. The authors concluded that at least during spring months, these habitats were avoided by black bears. In Big Bend National Park, Texas, black bears were found to avoid areas within 100 m of trails (Onoratol et al. 2003).

McCutchen (1990) suggests that the black bears in Rocky Mountain National Park do not become nuisance bears, or approach humans and human inhabited areas. The author, instead, suggests that the bears in the Park are generally shy and secretive because they had a history of being hunted previous to the park designation and because some bears likely have home ranges that extend out of the Park into areas where hunting is permissible.

Fimbel and Wolgast (1990) present the general conclusion that black bear den sites were affected by the distance to woodland trails. Conversely, Garner (1986), working at Shenandoah National Park, Virginia reports that both male and female bears utilize man-made trails for movements.

McClellan and Shackleton (1989a) found that grizzly bears exhibited stronger negative reactions to ground-based encounters with people, such as people on foot or moving vehicles, when they were in the open than when they had cover. The grizzly bears responded more strongly to people than to fixed-wing aircraft. Thirty-seven percent of grizzly bears fled people on foot within 1 km when encountering them in the open without cover. The presence of cover was important in reducing responses of grizzly bears to terrestrial human activities.

Mace and Waller (1996) reported little interaction between grizzly bears and humans in Montana. Apparently this was due to trail placement in heavily forested regions, a habitat that is not strongly utilized by grizzly bears. They also report a general increase in bear use as distance to trails and campsites increased

C. Roads and Road Closures

There may be direct and indirect impacts on black bears associated with the construction and operation of roads and road networks.

There is some evidence that unpaved roads represent less of a barrier to black bear movement than do paved roads, although it is difficult to sort out the behavioral responses of bears that are due to the type of road surface versus the lower traffic volumes often associated with unpaved roads. The direct impacts of roads upon bears can include: physical loss of habitat, including the loss of specific habitat elements such as riparian zones feeding areas (e.g. mast stands and wetlands), denning areas and movement corridors; as well as the loss of bears through direct mortality associated with road kill. The direct physical loss of habitat occurs when there is a conversion of useable bear habitat to dirt or paved surfaces during road construction and throughout the life of the road. In general, the larger (often meaning “wider”) the road, and/or road network being constructed and maintained, the greater the physical loss of bear habitat.

Roads can also have a negative indirect impact upon bears by bringing associated human activities such as increased access to hunting and increased home construction or timber harvesting, especially if these activities did not occur in the area previously.

1. Roads: Black Bears

There has been considerable research addressing the influence that roads have on black bear habitat use, as well as black bear avoidance behavior associated with roads and traffic. Studies on the impact of roads have focused on a variety of black bear behaviors including feeding, habitat selection, and hunter avoidance.

Some studies suggest that certain early succession plants associated with roads may attract bears. In the Great Smokey Mountains, Carr and Pelton (1984) report that female black bears used habitats that bordered roads. The authors determined that the generally more open habitats in near-road areas provided seasonal food sources for the bear and that bears continue to use these areas. Bears also frequently crossed low traffic roads in their study. Less traveled roads attracted bears in southern Ontario where foods and the ease of movement were suggested as the reasons bears continued to use these habitats (Coady 2001). Beringer et al. (1990), working in North Carolina, found that black bears utilized roadside habitats for feeding (mast and berries). In North Carolina, research indicates that black bears use food plants along abandoned roads, as well as utilizing these old roads for travel corridors (Brody and Pelton 1987). Garner (1986) found that in Shenandoah National Park, Virginia, female black bears utilized fire roads during the summer and early fall months.

In Louisiana, a recent study documented that black bears showed no avoidance or attraction to low-traffic roads or hiking trails (Hightower 2001). In both Louisiana and the Great Smokey Mountains (Carr and Pelton, 1984), the bear populations were not hunted. According to the study authors, this fact could have partially been responsible for the lack of negative avoidance behavior by the bears in their study areas. It appears that bears inhabiting areas where roads provide access to hunters are more wary of using these roads. A West Virginia study found that black bears utilized areas along limited access (gated) roads, trails, and right-of-ways where berry-producing shrubs were found (Miller 1975). In Vermont, Hammond (2002) found that the roadsides of dirt and gated roads were utilized by bears feeding on berries. In the West Virginia and Vermont studies, hunting of the bears was allowed. In the Vermont study, roads that were utilized by houndsmen in pursuit of bear with strike dogs were generally avoided by black bears (Hammond 2002).

The avoidance of roads by black bears at locations throughout the U.S. was noted in a wide variety of situations. The avoidance of roads by black bear was more pronounced as traffic flows increased. Hamilton (unknown date) found that black bears in Missouri did not cross roads that had daily traffic volumes of 10,000 vehicles/day. The authors suggest that roads with 10,000 vehicles/day were effectively barriers to black bear movements. Pelton (1990), however, suggests that these high volume roads impede bear movements but do not totally restrict them. McCown and Eason (2001) report that the paved Florida State Road 40, with traffic volume rates of 6,000 – 12,000 vehicles /day did not act as a significant barrier to black bear movements. The authors also found a similar crossing rate between male and female bears.

Working in the Pisgah National Forest in North Carolina, Beringer et al. (1990) report that black bears cross dirt roads and their movements are not affected by roads with traffic volumes below 100 vehicles/day. Beringer et al. (1990) suggest that as traffic volumes increase, road crossings by black bears decrease as they approach 10,000 vehicles/day. In North Carolina, Brandenburg (1996) reports that black bears cross dirt (secondary) roads to a greater degree than paved (primary) roads. These bears also cross roads more readily when traffic volumes are lower.

In North Carolina, Brody and Pelton (1989) report that black bears avoid crossing roads as the traffic volume increases, although they did not report on actual traffic volumes. They reported that black bears almost never crossed interstate highways, or high-volume paved roads. Brody and Pelton (1989) report no difference in the avoidance behavior of males and females, and no differences were noted based on the age of the bear.

Brown (1980) reported that in West Virginia, black bears did not generally cross well-traveled roads. Brown reports that males in particular avoided heavily-traveled roads and that female bears crossed lightly-traveled roads. Pelton noted similar avoidance behavior in West Virginia, with males being more sensitive to crossing all roads than females (1980).

In Vermont, Hammond (2002) reported that roads with volumes greater than 1400 vehicles/day precluded crossing by female bears and acted as partial barriers to male bears. Hammond also noted that where there were multiple parallel roads bears crossed these roads less often (2002).

Habitat Avoidance

The avoidance by black bears of habitat near roads has been shown in many locations throughout the U.S.. In the vast majority of these studies, the use of habitat within a specified distance to roads versus habitat use throughout the bears' range was measured. If the use of habitat by bears within the specified distances (away from roads) was less than that statistically expected, the bear was found to be "avoiding" the habitat in question. Thus, habitat that was "avoided" by bears was not necessarily unused, but used less than habitat found elsewhere throughout the bears' range.

Brown (1980) reports that male bears avoided habitats within 1 km of heavily traveled roads while females used habitats less up to within 0.5 km of these same roads. Female black bears used habitats near light-traveled roads to a greater degree than would be expected if its use was random. In Ontario, bears avoided heavily traveled paved highways and the habitats located within 500 m of such roads (Coady 2001), and in some cases up to 1000 m distant. Black bears in Montana were found to avoid habitats within 274 m of open dirt and gated roads (Kasworm and Manley 1990). Aune (1991), also reporting from Montana, found that black bears were avoiding open (non-gated) dirt roads and adjacent habitats within 100 m. Onoratol et al. (2003) also found that black bears generally avoided areas within 100 m of roads. Miller (1975), in West Virginia, found that when paved roads were present, black bears avoided the area within 0.5 km of the road. Miller (1975) also found a varying response to the use of habitats in dirt road corridors, with some bears utilizing this habitat and others avoiding it. Hammond (2002), working in Vermont, found in general that black bears avoided habitats within 100 m of all roads in his study area. Hammond also reports that adult females avoided habitats within about 300 m of roads and adult males avoided paved roads that had up to a 1,000 vehicles per day to a distance of 400 m.

Road Density

Several studies have addressed the density of roads within the home ranges of black bear. Hammond (2002) reported from Vermont that there were no black bear home ranges with road densities of greater than 1.41 km/km^2. He also reported that within his study area, there were no black bear home ranges where paved roads exceeded 0.46 km/km^2. In New Hampshire, Rossell (1990) found that black bears avoid forest roads when their density reached 0.5 km/km^2. Hillman and Yow (1986) suggest that for black bear home ranges, road densities not exceed 0.25km/km^2.

In the Adirondacks, Brocke et al. (1988) reported that with increased road densities, black bears experienced higher mortality rates. Brody and Pelton (1989) suggest that as road densities rise within a bear's home range, a threshold is reached, whereupon black bears abandon their habitats and seek new home ranges with lower road densities. The authors suggest that before reaching that road density threshold, bears adjust their movements within existing home ranges so as to minimize the risks associated with road crossings.

Brody and Stone (1987) modeled the relationship between logging-related road development and bear population dynamics. They suggested that increases in mortality would occur. In Arizona, as road density increased so did the human-caused mortality (Mollohan and LeCount 1989). The authors also noted a decrease in recruitment of bears into the local bear population.

Hunting

In several regions of the U.S., one of the major effects of roads and road access is increased mortality due to: (1) road kills from vehicular traffic; and (2) increased hunting pressures on black bear that result from easier access (particularly access gained by strike dogs) to bear populations.

Collins (1983) showed that in North Carolina, 73% of harvested black bears were taken within 1 mile of a road useable by a four-wheel drive vehicle. Beringer et al. (1990) reports that roads, whether gated or not, provide hunters and poachers with access to bears. Brody (1984) and Powell et al. (1992) report these findings as well. To prevent there use by hunters and poachers, Beringer et al. (1990) propose that roads be gated and locked; the authors suggest that the real issue with roads is not the roads themselves, but the access they provide to hunters and poachers. In New York's Adirondack Park, Brocke et al. (1988) also found that increased road densities are associated with excessive legal and illegal black bear harvests. These investigators also suggest the closure of roads to unlimited vehicular access.

In Vermont, Hammond (2002) postulated that some low-volume traffic roads were avoided by bears because of the use of these roads by houndsmen.

Road Closures

Access management has been suggested as perhaps the most important human activity within the control of resource managers that might affect black bears (Hillman and Yow 1986).

Several researchers have suggested that to mitigate the impacts of roads, vehicular traffic be restricted or gated. In New York, the closure of logging roads to lessen the access provided to hunters is suggested as part of an overall road mitigation proposal by Brocke (Brocke et al. 1988). Beringer et al. (1990) suggest the closing of existing roads that are unused for timber harvesting purposes, and putting gates and locks on new roads into black bear habitat. Working with black bears in California, Kelleyhouse suggests that smaller skid roads be gated or bermed to control access to hunters (1980). Kasworm and Manley (1990) also suggest in their study in Montana, that a system of road closures be implemented during and after energy development projects in order to partially mitigate for bear avoidance behavior.

2. Roads: Grizzly/Brown Bears

McLellan and Shackleton (1988) report on the effects on grizzly bears of roads constructed as part of resource extraction activities in southern Canada and Montana. They report an avoidance of habitats within 100 m of roads. Aune found an avoidance of 300 m distance from open roads for the grizzly bear in Montana (1991). Archibald et al. (1987), found that grizzly bears avoided habitats near logging roads actively hauling logs out of an area in remote British, Columbia, Canada. Bears avoided areas within 300 m of these roads while they were being actively used by logging trucks. The authors noted that grizzly bears began utilizing these same areas when the road was not being utilized by logging trucks.

Mattson et al. (1986), working in Wyoming, found that grizzly bears avoided habitats near roads exceeded 500 m. Female bears (both adults and subadults) showed the greatest avoidance behavior in their study area. Mace et al (1996) also found that most grizzly bears avoided roads with greater than 10 vehicles/day. Kasworm and Manley (1998), working in Montana, found that grizzly bears used habitats within 500 m of roads less than was expected.

Mace et al. (1996) found that no grizzly bears had home ranges when road (even dirt road) densities reached as high as 6.0 km/km^2. Mace et al. (1996) suggest that use of road side habitats was diminished when road densities exceed 1.2 km/km^2. Mace et al. (1996) also reported that most individual grizzly bears in the Yellowstone region reacted negatively or neutrally towards roads having 1-10 vehicles per day.

Kasworm and Manley (1989) conclude that seasonal and total road closures could benefit grizzly bears.

3. Temporal Activity Patterns Near Roads: Black and Grizzly Bears

Many bear researchers, those working with both black and grizzly bear, have noted that bears are, or become, nocturnal when near roads, developments, and more urban areas in general.

Bears become more nocturnal in their activity patterns (Beckman and Berger 2003) as their habitat urbanizes. Black bears crossing roads in Florida did so during the evening hours (McCown and Eason 2001). Hammond also found black bears crossed roads in

Vermont during crepuscular hours or evening (2002), as did Brandenburg in North Carolina (1996).

Grizzly bears utilize habitats near roads at night associated with energy development projects in the western U.S. (McLellan and Shackleton 1988). Mattson et al. (1986) also report that grizzly bears avoid roads and roadside areas during the daylight hours in Wyoming. In Alberta, Canada, crossing by grizzly bears was crepuscular or nighttime (Gilbeau et al., 2001).

4. Sex Differences Between Road Effects: Black and Grizzly Bears

Male black bears avoided roads to a greater degree in Shenandoah National Park than did females (Garner 1986). Male black bears were also found to avoid roads to a greater degree than females (Brown 1980). Hammond also found the greatest avoidance behavior (including avoidance of bear habitats) among male black bears in Vermont (2002).

In the northwest U.S., McLellan and Shackleton (1988) report a greater male avoidance of roads and near-road habitats in grizzly bears. However, working in Alberta, Canada, Gibeau et al., (2001) report that males were more likely to cross roads than were female grizzly bears. A greater aversion to roads and near-road habitats by adult female grizzly bears (especially those with cubs) was also noted by Mattson et al., (1986).

D. Energy and Resource Extraction Projects

The impacts of energy development projects on bears has been investigated in the far north (i.e., Alaska and Canada) and in the western United States. Both the grizzly bear and the black bear have been addressed, although most of the work has focused on impacts to the grizzly bear.

1. Black Bear

Research was conducted on the effects of energy development on black bears near oil development in Alberta, Canada. Tietje and Ruff (1983) report only minimal negative impacts to black bears following oil development. There was no identified effect upon bear behavior, or the distribution or abundance of bears. The authors go on to report that land alterations and construction noises had little affect on denning behavior by adult and subadult females and that females denned close to oil development activities.

Tietje and Ruff (1983) further suggest that female black bears with cubs might avoid the oil development areas more than other bears. In Alberta, the authors suggest that new roads associated with oil development with a concommitant increase in hunting pressure may have a greater effect on the numbers and behavior of black bears than that of habitat alteration and loss.

In Michigan, Manville (1983) reported that black bears denned within 200 m of oil-well activity. He goes on to state that hydrocarbon development in northern Michigan has benefited black bears by creating berry and mast crops, both of which are utilized by black bears as food. Bears were commonly located in close proximity to homes and oil wells. There has been no research (that the author is aware of) on the effects of this development and roads on hunting pressure and bear populations.

2. Grizzly Bear and Brown Bear

Several studies have looked at the effects of energy and resource development upon brown and grizzly bears (Smith and Van Daele, 1989; and Schallenberger, 1980).

There appears to be little evidence of avoidance behavior particular to oil or hydroelectric developments by grizzly or brown bears. Smith and Van Daele (1989) found no changes in home ranges, denning success, survivorship or cub production of brown bears resulting from the road building and construction of housing for up to 480 workers building the hydroelectric facility.

Smith and Van Daele (1989) suspect that bears did avoid roads that were associated with the project, but that the roads did not pose a serious barrier to bear movements. Dense cover along riverine environments provided enough security that bears continued to use rivers to hunt for salmon. Simpson (1980) found that grizzly bears continued to use areas close to human activities where cover was complete or adequate. Smith and Van Daele (1989) conclude that the effects of hydroelectric development were temporary and limited to the immediate vicinity, probably within 2 km of construction sites. The authors go on to suggest the increased access to hunters and recreationists will likely have the greatest impact upon the local brown bear population.

The effects of seismic exploration, timber harvest, and associated roads were investigated in southern Canada and Montana (McLellan and Shackleton 1988). The authors found little displacement activity on grizzly bears. Bears avoided heavy equipment carried by helicopters at distances up to 200 m. Timber harvesting activity resulted in the displacement of resident bears. Bear behavior was only affected when bears were utilizing open habitats without much cover.

Reynolds et al. (1984) reports that grizzly bears exhibit elevated heart rates in dens when subjected to the sounds of seismic vehicles within 5/8 miles from the den. Dens were not, however, abandoned by bears. Reynolds et al. (1986) reported that grizzly bears in Alaska reacted by moving in their dens when there were detonations (for seismic purposes) within 0.8-1.2 mi. of den sites. When vehicles were operated within 3,300 ft. of den sites the heart rates of bears were elevated. The same authors report a case of den abandonment when blasting activity occurred within 650 ft of the den site, but a different den site was not abandoned by a mother and cub when blasting occurred within 325 ft of the den.

Resource extraction activities resulted in 2 of 11 grizzly bears displaying significant difference in habitat use, including a slight displacement of denning activity. Most changes in habitat use were associated with low, open cover habitats (McLellan and Shackleton, 1989).

Helicopter traffic was found to disturb brown bears (Smith and Van Daele 1989) and, to a lesser extent, grizzly bears (McLellan and Shackleton 1989) at gas exploration sites in Montana and Alberta. Grizzly bears moved off slowly as helicopters flew low to the ground, and in some cases, only after hours of disturbance. Brown bears were less likely to utilize more open alpine areas when helicopters were used (Smith and Van Daele 1989). The presence of cover was deemed important in determining whether brown bears fled. In general, the greater the cover, the less the bear fled in response to helicopter traffic.

The major effects of resource extraction behavior were the avoidance of roads associated with the activity, discussed above.

E. Recreational Activities

1. Black Bears

In Vermont, Hammond (2002) reported that black bears selected for winter dens in locations remote (generally over 1000 feet) from alpine ski areas and snowmobile trails. Adult male bears selected den sites furthest away from residential structures and roads (generally over 2200 feet).

Hammond (2002) reported that in areas with ski trails relatively remote from resort developments and housing units, bear use was common, although use of American beech as a food source was less intense than at very remote locations.

Use of the golf course by black bears was also found to be less than expected (compared to random use) at the Vermont site (Hammond 2002). This result could possibly be confounded, to some degree, by the avoidance of roads and resort development that also surround the golf course.

Black bears in Shenandoah National Park in Virginia, rarely came within 100 m of campgrounds, picnic areas and other human disturbances (Garner 1986).

2. Grizzly Bears

Grizzly bears in Yellowstone National Park underused habitats within 0.8 - 1.0 km of campsites (Gunther 1984). Mattson reports that this avoidance behavior was only evident at campsites with greater than 40 people/month at the sites (1990). The activities of grizzly bears were disrupted up to distances of 2.5 km of backcountry campsites (Zunino 1981).

F. Residential Land Use

1. Black Bear

Fimbel and Wolgast (1990) report a greater frequency of black bear den sites as distances to public roads and occupied residential dwellings increase. Conversely, in

Massachusetts, Elowe reports that bears do not exhibit much avoidance behavior around human dwellings (Mass Website).

Hammond (2002) reports that in Vermont, female black bears were generally found closer to houses, and sub-adult and adult females generally had more houses within their home ranges. Sub-adult bears failed to avoid houses in most seasons, but did avoid houses during the fall season. In Michigan, Manville (1983) reported that black bears used habitats near houses and oil wells (no distances were presented).

2. Grizzly Bear

Mattson, Knight, and Blanchard (1986) found no real avoidance of developments within 2 km in Yellowstone National Park, Wyoming. Bear use did decrease at 2-5 km from development activity. In general, all bears were found to avoid humans and the busiest front-country facilities. The authors found that female grizzly bears with cubs avoided human encounters the most.

V. Interviews with Wildlife Management Experts

During the course of the literature review, numerous out-of-state bear experts and bear management personnel were contacted. These individuals were asked if they had any information or knowledge of unpublished bear research or of energy projects where bear issues had arisen or been addressed.

None of the bear experts or managers had extensive experience with the question of wind projects and their potential impact on bears. State and provincial bear management personnel from Montana, Idaho, Utah, Washington, Colorado, Maine, New Hampshire, Massachusetts, Minnesota, Alberta, and Ontario were contacted. None of these individuals were aware of unpublished bear literature (or of literature that I had not already obtained) or of on-going research that would address the potential impacts of wind projects (or energy development) on bears. The individual from Montana stated that he did not see the impacts as an issue (Keith Aune, personal communication).

Personnel from the State of California stated that they managed the black bear under the rubric of protecting the mountain lion. That is, they felt that if the mountain lion was adequately protected during the development and operation of wind projects, the black bear would also be protected (Doug Updike, personal communication).

In the state of Maine, personnel addressing black bear and a proposed wind project did not believe that the issue was a large concern for black bears and therefore did not require the wind project applicants to study the potential impacts (Jennifer Vashon, personal communication).

In addressing a proposal for wind development in Massachusetts, no literature or research addressing the potential impacts of the development on black bears could be located (James Cartoza, personal communication).

A researcher from Minnesota felt that the low-vehicular traffic access roads would be utilized by black bears for movement across the landscape (Lynn Rogers, personal communication).

If any general statements of concern can be garnered from discussions with researchers and managers, they center on the amount of traffic allowed on access roads (the greater the traffic volumes, the greater the potential impact), and on the amount of access that roads would allow the general public, especially bear hunters.

VI. <u>Results from the Federal Environmental Impact Statement Search</u>

A computerized key-word search of Federal Environmental Impact Statements (EIS) involving energy developments (particularly wind projects) and bears conducted through the University of Vermont yielded several references to western oil and gas energy projects. A few of these EIS documents were consulted but none of these documents presented any research or original information concerning bears and energy developments. At the time of the computerized review (late 2004-early 2005), there were no EIS documents addressing wind projects and the potential impact on bears.

VII. <u>Application of Research Findings to the Proposed Deerfield Wind Farm</u>

The following section draws out important points from the research review and applies it to the proposed Deerfield Wind Farm.

A. <u>Tourism, Recreation, and Trails</u>

Black bears generally avoid hiking trails and the habitats surrounding them. Based on limited research, areas near trails are avoided to a distance of about 100 m, and possibly to 305 m. Based on very limited evidence, grizzly bears appear to react negatively to humans on foot at a distance of 1 km. Based on limited information, black bears generally avoid recreational facilities such as campgrounds, golf courses, and ski areas. More remote habitat within ski areas, even with ski trails present, are utilized by black bears, although some evidence suggests that important food sources such as American beech stands are under-utilized in these areas. Limited evidence suggests that female black bears select den sites over 300 m away from ski trails, and males over 600 m.

The Deerfield Wind Farm will involve limited foot traffic by maintenance personnel, which may be likened to low to moderate volume use of hiking trails.

B. <u>Roads and Road Closures</u>

There is considerable evidence that black bear are attracted to habitats that is adjacent to low-traffic volume roads because they provide important early succession plant communities, including berry-producing plants.

There is also considerable evidence that high-traffic roads (all paved), and moderate-traffic volume paved and dirt roads as well as the habitats adjacent to them are avoided by black bears. Evidence suggests that the strength of the road avoidance behavior in black bears is positively correlated with traffic volumes. Roads with low traffic volumes generally are little avoided by black bears; although some work has suggested that the bears generally avoided habitat within 100 m of dirt and other low-moderate volume roads. There also may be sexual differences in the willingness of bears to cross roads.

When road densities become too high, black bears avoid roads and may abandon home ranges. Based on limited research, road densities (both paved and unpaved) within black bear habitats may become too high when they exceed approximately $0.5 km/km^2$.

Furthermore, researchers have shown that open, non-restricted roads provide access to bear hunters, and the problem of excessive mortality with an increase in this access is a possibility. Such an increase in mortality associated with roads may be greater in areas where hunters use strike dogs to hunt bear. Investigators have suggested that closing roads, seasonally or permanently, can help to mitigate problems associated with increased road access. In addition, researchers have shown that there is often an increase in crepuscular and nighttime activity near road environments.

The proposed Deerfield Wind Farm will involve the construction of approximately 4 miles of new road. The portion of service roads along the ridgelines are expected to be approximately 35 feet wide during construction and be reduced to about 16 feet in width after construction. The rest of the access roads will be created and maintained at a width of 22 feet. The roads will be graveled as opposed to paved. Expected traffic on the service roads will be minimal as much of the facility operation is monitored from operations at the bottom of the mountain. Given the character, size, and frequency of use on the service roads, they are most comparable to low traffic, unpaved roads found in bear studies. As mentioned, low traffic roads tend to have minimal impact on bears. Furthermore, gating the service roads will limit access by hunters and other recreationalists.

C. <u>Energy and Resource Extraction Projects</u>

There has been very limited research on the effects of any form of energy development or resource extraction projects on the black bear. The research that has been done shows minimal displacement of black bears and minimal disturbance by noise and activity associated with oil development. The authors suggest a possible greater avoidance of the actual oil well site by female bears with cubs, but black bear denning was reported within 200m of active oil wells. Researchers hypothesize that the main impact of oil development could be associated with increased hunter access via project roads. There is some evidence to suggest that the impacts of energy developments have been local in nature.

In light of human developments, black bears become increasingly nocturnal. Black bear habitat use in the vicinity of the proposed Deerfield Wind Farm may become more nocturnal.

VIII. Recommendations for Wind Development Projects

Although research into the impact of wind projects on black bears is limited, given studies that have been done on the effects of roads, recreation, and other human activities, it is possible to suggest steps that might be taken to mitigate as many potential negative impacts of wind development as possible. What follows are some recommendations and an assessment of how Deerfield Wind LLC's plans have addressed these recommendations.

1. Recommendation: Wind project developments in Vermont should strictly limit the traffic volumes on access roads. Wind project access roads should be gated and closed to the general public.

   Deerfield: Roads will be gated and closed to the general public. The project-related traffic volume during operation is expected to be very low – on average a few vehicle trips per day. Higher traffic volumes will occur during construction, and may result in avoidance of the area by black bear; this would be a short-term impact.

2. Recommendation: There is some evidence to suggest that black bears exhibit less of an "avoidance response" to unpaved roads than to paved roads. Wind project access roads should remain unpaved.

   Deerfield: Roads will be unpaved.

3. Recommendation: There is some evidence to suggest that the narrower the road and clearing associated with the road, the less it will deter black bears from crossing. Wind projects should build roads as narrow as possible.

   Deerfield: Construction widths will be no wider than necessary to move turbine components and construction equipment to the site. The ridge roads will be 35 feet wide during construction and will be allowed to grow back until they are only 16 feet wide. The rest of the access roads will be created and maintained at a width of 22 feet.

4. Recommendation: If early succession habitats are created near gated, low traffic volume access roads, these habitats could attract black bears.

   Deerfield: It is unlikely that extensive early successional habitats will develop along the project road sides or turbine sites. A narrow fringe of early successional plants such as berry-producing shrubs may grow along the access roads and turbine sites. However, as the clearing of vegetation associated with this project is limited in area, the edge habitats created in these areas are not likely to act as a major attractant to black bears.

5. Recommendation: Bear hunters should not be given vehicular access to wind project access roads. Wind project developers should consider banning the use of access roads by bear hunters and their dogs.

   Deerfield: The service road entrance will be gated.

6. Recommendation: It appears that black bear habitat quality declines as road density increases. Roads associated with wind projects should be minimized.

   Deerfield: Deerfield Wind LLC plans to build only the roads necessary to construct, operate and maintain the project. It is expected that about 4 miles of new road will need to be constructed for this project. The ridge roads will be 35 feet wide during construction and will be allowed to grow back until they are only 16 feet wide. The rest of the access roads will be created and maintained at a width of 22 feet.

7. Recommendation: Wind developers should not construct parallel access roads, and should greatly limit or eliminate the use of guardrails in road construction.

   Deerfield: Guardrails will not be utilized, nor does the project involve the use of parallel roads.

8. Recommendation: The presence of vegetative cover (versus open areas) functioned to mitigate negative impacts associated with energy developments. Forest and overall vegetative cover near wind projects should be left in place.

   Deerfield: As much vegetative cover as possible will be left in place. Cleared areas will be allowed to revegetate to the greatest extent practicable.

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